Continuous Noninvasive Measurement of Hemoglobin via Pulse CO-Oximetry.
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Background

New advances in pulse oximetry technology have led to the development of multi-wavelength pulse CO-Oximeters designed to measure multiple physiologic parameters. The utilization of multiple wavelengths has led to the development of a prototype pulse CO-Oximeter that allows for measurement of continuous hemoglobin concentration (SpHb). This study examines this device's ability to measure continuous SpHb and evaluates the accuracy compared with hemoglobin concentration (Hb) measured in a laboratory CO-Oximeter.

Methods

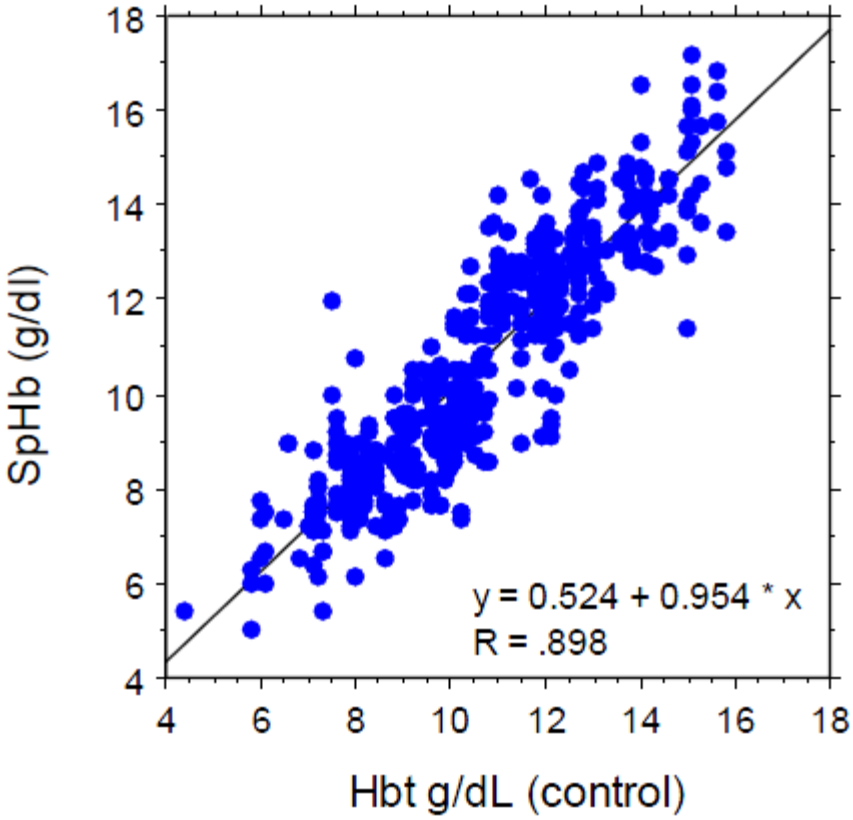
After IRB approval and informed consent, 19 patients scheduled to undergo surgery and 9 healthy volunteers undergoing a hemodilution protocol were enrolled in this ongoing study. Each subject was monitored with ASA standard monitors and a radial artery cannula. Three prototype SpHb sensors, optically isolated from each other, were attached to a data collection system (Masimo Corp., Irvine, CA). Routine anesthetic care of these patients was not altered. The hemodilution protocol consisted of withdrawal of 1 unit of blood and replacement with 30ml\kg of saline. Data was collected throughout the course of each surgery and during hemodilution. Arterial blood samples were analyzed by laboratory CO-Oximeter (Radiometer ABL735), and the resulting Hb measurements were compared with the data collected from the corresponding SpHb readings. Regression analysis and bias, precision and ARMS were calculated.

Results

458 data pairs were collected from a total of 28 subjects (16.3 + 8.1 per subject). The mean (+ SD) and range of Hb values were 10.6 (+ 2.3) and 4.4 to 15.8 g/dl respectively. Bias, precision and A_{RMS} were -0.039, 1.09, 1.09 respectively. The figure shows the correlation between Hb and SpHb and the regression analysis. The y intercept is 0.524 and the slope is 0.954 and the correlation coefficient is 0.898.

Conclusion

This device is the first device developed that can continuously and noninvasively measure hemoglobin concentration in addition to the other common hemoglobin species, and therefore provides a significant expansion existing physiologic monitoring technology. Rapid measurement of hemoglobin would be an extremely useful in many clinical scenarios. This technology in combination with methemoglobin and carboxyhemoglobin measurements should allow for significant advances in patient care.


SpHb (g/dl)
Hbt g/dL (control)
y = 0.524 + 0.954 * x
R = .898
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